MC900150927[1]**MIDTERM EXAM**

***Review***

Unit 1 🡪 Introduction, Chemistry, and Matter

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| chemistry | matter | mass |
| weight | scientific method | qualitative data |
| quantitative data | hypothesis | experiment |
| independent variable | dependent variable | control |
| conclusion | model | theory |
| scientific law | pure research | applied research |
| technology | substance | physical property |
| intensive property | chemical property | states of matter |
| solid | liquid | gas |
| vapor | physical change | chemical change |
| law of conservation of mass | mixture | heterogeneous mixture |
| homogeneous mixture | solution | filtration |
| distillation | crystallization | chromatography |
| element | periodic table | compound |
| law of definite proportions | percent by mass | law of multiple proportions |
| extensive property |  |  |

*Objectives*

* **Define** chemistry and matter.
* **Compare** and **contrast** mass and weight.
* **Explain** why chemists are interested in a submicroscopic description of matter.
* **Identify** the common steps of scientific methods.
* **Compare** and **contrast** types of data.
* **Compare** and **contrast** types of variables.
* **Describe** the difference between a theory and a scientific law.
* **Compare** and **contrast** pure research, applied research, and technology.
* **Apply** knowledge of laboratory safety.
* **Identify** the characteristics of a substance.
* **Distinguish** between physical and chemical properties.
* **Differentiate** among the physical states of matter.
* **Define** physical change and list several common physical changes.
* **Define** chemical change and list several indications that a chemical change has taken place.
* **Apply** the law of conservation of mass to chemical reactions.
* **Contrast** mixtures and substances.
* **Classify** mixtures as homogeneous or heterogeneous.
* **List** and **describe** several techniques used to separate mixtures.
* **Distinguish** between elements and compounds.
* **Describe** the organization of elements on the periodic table.
* **Explain** how all compounds obey the law of definite and multiple proportions.

*Short Answer and Problem-Solving*

1. Classify the following materials listed below. Write “E” for element, “C” for compound, “S” for solution, or “H” for heterogeneous mixture.

propane gas

chocolate chip cookie dough

lithium metal

salt water

1. Distinguish between the types of properties in the example below. Circle your answers.

color **chemical physical**

reactivity **chemical physical**

solubility **chemical physical**

combustibility **chemical physical**

length **chemical physical**

1. Determine the percent composition of oxygen in the compound Fe(OH)2.

Unit 2 🡪 Data Analysis

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| base unit | second | meter |
| kilogram | derived unit | liter |
| density | Kelvin | scientific notation |
| conversion factor | dimensional analysis | accuracy |
| precision | percent error | significant figure |
| graph |  |  |

*Objectives*

* **Define** SI base units for time, length, mass, and temperature.
* **Explain** how adding a prefix changes a unit.
* **Compare** the derived units for volume and density.
* **Express** numbers in scientific notation.
* **Use** dimensional analysis to **convert** between units.
* **Define** and **compare** accuracy and precision.
* **Use** significant figures and rounding to reflect the certainty of data.
* **Use** percent error to **describe** the accuracy of experimental data.
* **Create** graphs to reveal patterns in data.
* **Interpret** graphs.

*Short Answer and Problem-Solving*

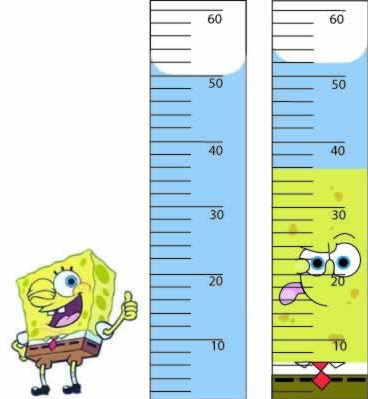
1. Perform the following conversions using dimensional analysis.

|  |  |  |  |
| --- | --- | --- | --- |
| **1 kg = 2.2 lbs** | **1 L = 34 oz** | **3 ft = 1 yd** | **1 kg = 1000 g** |
| **1 L = 1000 ml** | **1000 mg = 1 g** | **5280 ft = 1 mile** | **1 m = 1.13 yd** |

How many milligrams are equal to 3.0 kg?

There are about 25 miles between Upper Dublin and Philadelphia. How many meters are in between the two?

The density of titanium is 4.5 g/ml. Convert this density to lbs/oz.

1. Calculate the density of Sponge Bob using the diagram (measuring in milliliters) below. Assume he has a mass of 21 g.
2. A student measured the temperature of boiling water and got a measurement reading of 97.5 °C. If the actual boiling point of water is 100 °C, what is the student’s percent error?

Unit 3 🡪 Atomic Structure and Nuclear Chemistry

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| Dalton’s atomic theory | atom | cathode ray |
| electron | nucleus | proton |
| neutron | atomic number | isotope |
| mass number | atomic mass unit (amu) | atomic mass |
| nuclear reaction | radioactivity | radiation |
| radioactive decay | alpha radiation | alpha particle |
| nuclear equation | beta radiation | beta particle |
| gamma ray | radioisotope | x ray |
| strong nuclear force | band of stability | positron emission |
| positron | electron capture | radioactive decay series |
| nucleon | transmutation | induced transmutation |
| transuranium element | half-life | radiochemical dating |
| mass defect | nuclear fission | critical mass |
| breeder reactor | nuclear fusion | thermonuclear reaction |
| ionizing radiation | radiotracer |  |

*Objectives*

* **Compare** and **contrast** the atomic models of Democritus and Dalton.
* **Define** an atom.
* **Distinguish** between the subatomic particles in terms of relative charge and mass.
* **Describe** the structure of the nuclear atom, including the locations of the subatomic particles.
* **Explain** the role of atomic number in determining the identity of an atom.
* **Define** an isotope and **explain** why atomic masses are not whole numbers.
* **Calculate** the number of electrons, protons, and neutrons in an atom given its mass number and atomic number.
* **Explain** the relationship between unstable nuclei and radioactive decay.
* **Characterize** alpha, beta, and gamma radiation in terms of mass and charge.

*Short Answer and Problem-Solving*

1. Complete the following table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Atomic #** | **Mass #** | **# Protons** | **# Neutrons** | **# Electrons** |
| 8 |  |  | 8 |  |
|  | 59 |  | 31 |  |
|  |  |  | 21 | 20 |

1. Calculate the atomic mass of magnesium given the information below.

|  |  |  |
| --- | --- | --- |
| **Isotope** | **Mass** | **% Abundance** |
| 24Mg | 23.98504 | 78.70 |
| 25Mg | 24.98584 | 10.13 |
| 26Mg | 25.98259 | 11.17 |

1. Write an equation for the emission of an alpha particle from Ra-226.
2. Determine whether carbon-14 is stable or unstable. If it is an unstable isotope, write the nuclear equation for its most likely decay reaction.
3. What is the half-life of a substance that decays from 12.0 g to 3.0 g in 18 seconds?

Unit 4 🡪 Electrons in Atoms

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| electromagnetic radiation | wavelength | frequency |
| amplitude | electromagnetic spectrum | quantum |
| Planck’s constant | photoelectric effect | photon |
| atomic emission spectrum | ground state | de Broglie equation |
| Heisenberg uncertainty principle | electron-dot structure | atomic orbital |
| principal quantum number | principle energy level | energy sublevel |
| electron configuration | aufbau principle | Pauli exclusion principle |
| Hund’s rule | quantum mechanical model of the atom | valence electron |

*Objectives*

* **Compare** the wave and particle models of light.
* **Define** a quantum of energy and **explain** how it is related to an energy change of matter.
* **Contrast** continuous electromagnetic spectra and atomic emission spectra.
* **Compare** the Bohr and quantum mechanical models of the atom.
* **Explain** the impact of de Broglie’s wave-particle duality and the Heisenberg uncertainty principle on the modern view of electrons in atoms.
* **Identify** the relationships among a hydrogen atom’s energy levels, sublevels, and atomic orbitals.
* **Apply** the Pauli exclusion principle, the aufbau principle, and Hund’s rule to write electron configurations using orbital diagrams and electron configuration notation.
* **Define** valence electrons and draw electron-dot structures representing an atom’s valence electrons.

*Short Answer and Problem-Solving*

1. Use the information provided below to solve the following problems.

|  |  |  |  |
| --- | --- | --- | --- |
| **c = 3.00x108 m/s** | **h = 6.626x10-34 Js** | **E = hν** | **c = λν** |

1. What is the wavelength of light with a frequency of 1.00x1020 Hz?
2. What is the energy of a photon of light with a wavelength of 3.00x10-8 m?
3. Which of the two waves in the questions above has greater energy (wave a or wave b)? Support your answer. You can demonstrate this with math or explain it in essay form.
4. Use the periodic table to answer the following questions about arsenic.
5. Give the ground state electron configuration (long-hand notation).
6. Write the electron configuration using noble gas notation.
7. Draw its orbital diagram.
8. Illustrate its electron dot structure.

Unit 5 🡪 The Periodic Table

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| periodic law | group | period |
| representative element | transition element | metal |
| alkali metal | alkaline earth metal | transition metal |
| inner transition metal | nonmetal | halogen |
| noble gas | metalloid | ion |
| ionization energy | octet rule | electronegativity |

*Objectives*

* **Trace** the development and identify key features of the periodic table.
* **Explain** why elements in the same group have similar properties.
* **Identify** the four blocks of the periodic table based on electron configuration.
* **Compare** period and group trends of several properties.
* **Relate** period and group trends in atomic radii to electron configuration.

*Short Answer and Problem-Solving*

1. Match the following descriptions with the correct corresponding elements. Write the letters of the answers on each blank line. Not every letter will be used.

\_\_\_\_\_ alkali metal in the 4th period **A** – barium

\_\_\_\_\_ transition metal that is liquid at room temperature **B** – bromine

\_\_\_\_\_ halogen in the 2nd period **C** – chlorine

\_\_\_\_\_ noble gas with an electron configuration of 1s2 **D** – fluorine

\_\_\_\_\_ alkaline earth metal in the 6th period **E** – helium

\_\_\_\_\_ 2 valence electrons in the 7th energy level **F** – mercury

**G** – potassium

**H** – radium

1. Compare/contrast the electronegativity values of the following elements. Use the symbols >, <, or =.

H Mg C N F I